Space Weather Technical Forecast

Issued on Wednesday, 17 April 2024 at 01:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares likely and a slight chance of X-flares. G1-G2/Minor-Moderate Geomagnetic storming expected at times Day 1, 2 and 4 (17, 18 and 20 Apr).

Solar Activity: Activity is currently Moderate. The largest flare was an M1.1 event at 16/1802 UTC from AR3637. Background flux is well within C-class levels.

There are up to fifteen sunspot regions currently visible on the disc. AR3639 in the northeast is the largest and provides the bulk of the flare risk, with a now consolidated large, asymmetric main trailer spot and two small delta spots having developed. AR3634 in the northwest is the second largest, with large lead and trailer spots, but few if any intermediate spots. The complex multi spot region in the southeast contains the small region AR3637, which has a small delta spot within the leading portion of the group. AR3642 in the northwest has decayed. Remaining regions appear generally more stable with only slow evolution. New regions currently rotating over the eastern horizon appear magnetically simple, but may reveal more complexity as they transit further onto the Earth-facing disc.

A filament eruption was observed in the southeast disc starting around 16/1930 UTC. Further imagery is necessary in order to determine if there is any Earth-directed component from the resultant CME.

Solar Wind / Geomagnetic Activity: Solar wind parameters were indicative of ongoing CME influence during the period. Solar winds as observed by DSCOVR at L1 were largely slow-ambient, but with a peak of 422km/s (slightly elevated) observed at 16/1546 UTC. Density varied between above average and average levels, peaking at 21 ppcc at 16/1734 UTC. The Interplanetary magnetic field (IMF) strength, Bt, was predominantly moderate, with a maxima of 13nT at 16/1307 UTC. The north-south component, Bz, was moderately negative for large parts of the period, varying between +8/-13nT. Phi angle was mostly negative (towards the Sun), until around 16/0930 UTC after which it was mostly positive (away from the Sun). Resultant geomagnetic activity was Kp2 (Quiet) to Kp6 (G2/Moderate Storm).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was background to moderate. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 9.46e5 integrated pfu observed at 16/2359 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with occasional M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: Despite background solar wind speeds, current geomagnetic conditions remain enhanced following a CME arrival late on 15 Apr. This is expected to slowly ease early day 1 (17 Apr) ahead of further CME influence on days 1 and 2 (17 and 18 Apr) given the potential for glancing blows from CMEs that left the sun on the 14 and 15 Apr. During day 4 (20 Apr) a recurrent coronal hole high-speed stream is expected to arrive at Earth, likely increasing speeds to slightly elevated or elevated levels.

Geomagnetic activity is expected to be at generally Active to G1/Minor Storm levels on day 1 (17 Apr), with a chance of G2/Moderate Storm conditions at peak. Unsettled to G1/Minor Storm conditions are forecast on day 2 (18 Apr), easing to Quiet to Unsettled on day 3 (19 Apr). On day 4 (20 Apr) Quiet to G1/Minor Storm conditions are expected.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18 is expected to persist at background. High energy electron flux as observed by GOES-16 is expected to remain at generally background to moderate levels. The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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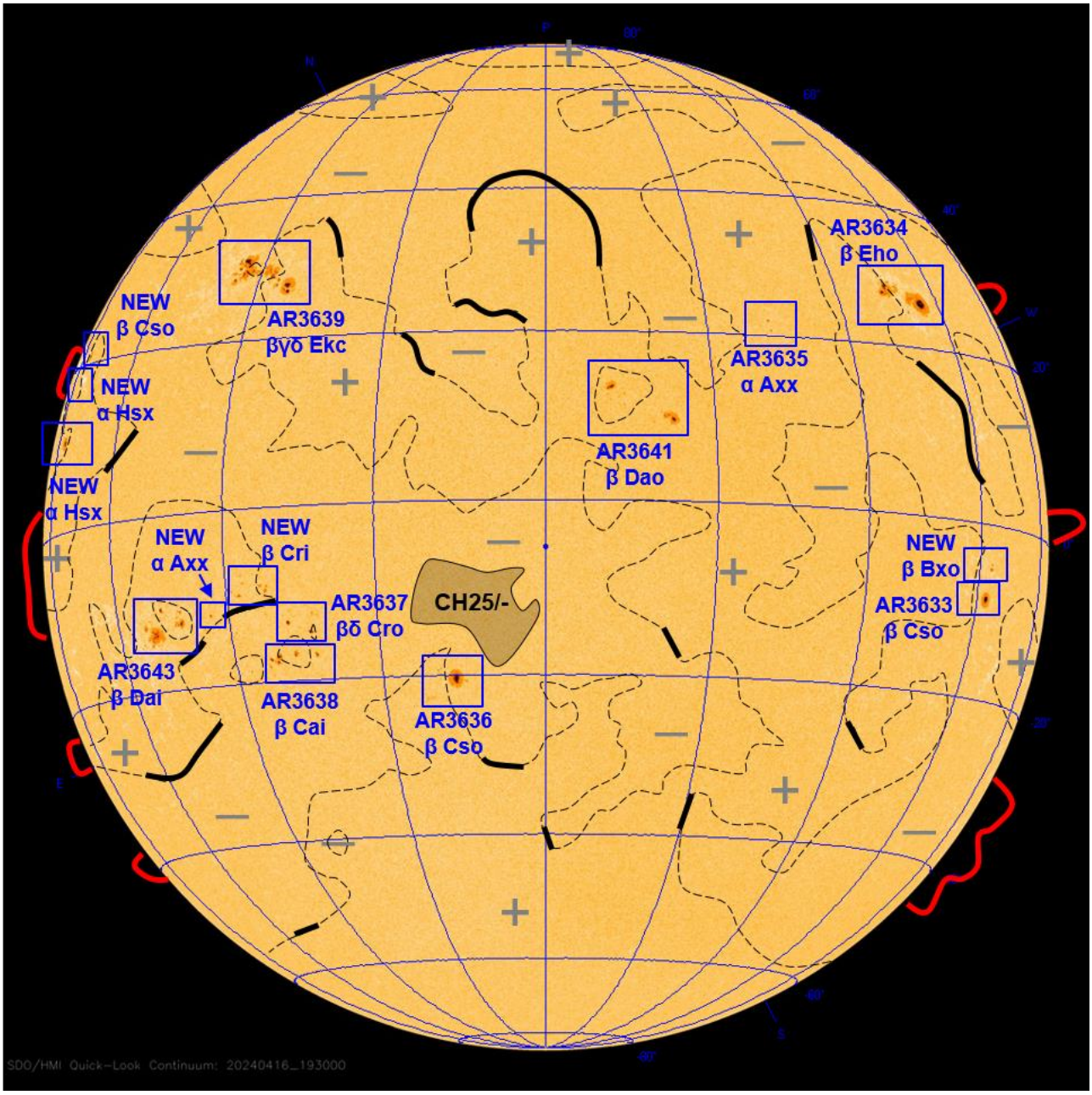
Figure 1. Solar Analysis Valid 16/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

CME influence expected to dominate the near Earth environment during the early period, followed by a coronal hole enhancement at the end of the forecast.

Despite background solar wind speeds, current conditions remain enhanced following the CME arrival late on the 15 Apr, this continuing to slowly ease during early day 1 (17 Apr). Further CME influence is expected on days 1 and 2 (17-18 Apr) given the potential for glancing blows from CMEs that left the sun on 14 and 15 Apr. The first of these is from a joint flare and filament eruption in the southeast disc on 14 Apr. The second was associated with a CME eruption which left the northeastern quadrant of the Sun around 15/0549 UTC. Modelling suggests these are likely to impact Earth day 1 and 2 (17 and 18 Apr), though with somewhat lowered confidence in geomagnetic effects given potential interactions between the two features and a previously disturbed magnetosphere resulting from the arrival of the CME on 15 Apr.

A large filament eruption from the southeast disc late on 16 Apr is still awaiting further imagery to analyse any potential for an Earth-directed CME.

Coronal hole 25 is expected to become geoeffective on day 4 (20 Apr). This is a persistent feature and gave peak speeds of around 550km/s on the previous rotation. Although the coronal hole itself appears smaller than on the previous rotation, its equivalent position on the disc remains similar, so persistence forecasting for the onset carries moderately-high confidence, though likely with slightly lower peak speeds than seen in March, estimated to be around 500km/s.

Geomagnetic activity is expected to be at generally Active to G1/Minor Storm levels on day 1 (17 Apr), with a chance of G2/Moderate Storm conditions at peak. Unsettled to G1/Minor Storm conditions are forecast on day 2 (18 Apr), easing to Quiet to Unsettled on day 3 (19 Apr). On day 4 (20 Apr) Quiet to G1/Minor Storm conditions are expected.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	70	50	5	50
Strong	G3	No	10	5	1	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1553	Partial	Flare and Filament Eruption	SE	680 km/s	17/0900 UTC +/- 6 hours	Glancing impact
15/0549	Partial	Flare and Filament Eruption	SE	640 km/s	18/0300 UTC +/- 6 hours	Low confidence

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Radio Blackouts - X-Ray Flares:

Solar activity is currently Moderate with up to fifteen sunspot regions now on the disc and background flux well within the C-class level. The majority of activity has originated from AR3639 (Ekc/Beta-Gamma-Delta) in the northeast, AR3634 (Eho/Beta) in the northwest and a cluster of small regions that appear to be magnetically linked in the southeast disc. The former provides the majority of the significant flare risk, with a large asymmetric main trailer spot and two small delta spots. A small delta spot is apparent with AR3637 in the southeast and appears to have been the source of the M1.1 flare at 16/1802 UTC. The proximity of this region to other small regions is likely to enhance magnetic complexity in this part of the disc and therefore elevate the likelihood of further significant flares should the regions persist. Three new regions have recently rotated over the northeast limb and appear to be mature, largely stable regions, though may reveal more complexity as they transit further onto the Earth-facing disc.

Overall Moderate activity is expected to continue, with occasional M-class flares likely and a slight chance of isolated X-class flares and the risk remaining consistent through the period pending further developments.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	15	15	15	15

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Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES18 has persisted at background levels and is expected to generally remain so. There is a slight chance of the observed flux increasing in response to any notable flares however, primarily from AR3634 at first with this region moving towards the western limb. As the region rotates over the western horizon by day 4 (20 Apr) other regions currently in the eastern disc will be in a more favourable position for proton rich flares to be observed at GEO.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels with likely ongoing geomagnetic activity expected to generally suppress values in the coming days.

The associated 24hr electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, with current REFM output broadly accepted as good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 3: Latest GOES-16 >2MeV Electron Flux (above) and MOSWOC REFM output and recurrence forecast (below)

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